REALISTIC®

SOLID STATE

FOUR BAND COMMUNICATIONS RECEIVER

SERVICE MANUAL

MODEL DX—150A

CAT. No. 20—150

A PRODUCT OF RADIO SHACK®

DIVISION OF TANDY CORPORATION

CONTENTS

1. SPECIFICATION
2. GENERAL ARIGNMENT INSTRUCTIONS
3. INSTRUCTIONS FOR REPLACEMENT OF CHASSIS
4. PARTS LIST AND DESCRIPTION
5. FIG. 1 FRONT VIEW OF DX-150A CHASSIS
6. FIG. 2 TOP VIEW OF DX-150A CHASSIS PARTS LOCATION
7. FIG. 3 REAR VIEW OF DX-150A CHASSIS PARTS LOCATION
8. FIG. 4 SCHEMATIC DIAGRAM
9. FIG. 5 CHASSIS DIS-ASSEMBLY
10. FIG. 6 KNOB & SHAFT ASSEMBLY FOR BANDSPREAD
11. FIG. 7 KNOB & SHAFT ASSEMBLY FOR BFO PITCH
12. FIG. 8 PHONES JACK ASSEMBLY
13. FIG. 9 MAIN TUNING DIAL CORD ASSEMBLY
14. FIG.10 BANDSPREAD DIAL CORD ASSEMBLY
15. FIG.11 SUB PRINTED CIRCUIT BOARD TOP VIEW
16. FIG.12 SUB PRINTED CIRCUIT BOARD REAR VIEW
17. FIG.13 MAIN PRINTED CIRCUIT BOARD TOP VIEW
18. FIG.14 MAIN PRINTED CIRCUIT BOARD REAR VIEW
19. FIG.15 MAIN PRINTED WIRING DIAGRAM

Table 1. Transistor & diode complement

Number	Type	Function
Q 1	2SK19	Cascade RF stage
Q 2	2SC373	AVC amplifier
Q 3	2SK19	Cascade RF stage
Q 4	2SK19	Mixer
Q 5	2SC372	1st IF amplifier
Q 6	2SC372	2nd IF amplifier
Q 7	2SK19	Local oscillator
Q 8	2SC372	B.F.O. stage
Q 9	2SC372	Buffer stage
Q 10	2SC373	Amplifier for CW/SSB
Q 11	2SC373	1st AF amplifier
Q 12	2SC373	2nd AF amplifier
Q 13	2SD72	AF power amplifier
Q 14	2SD72	AF power amplifier
Q 15	2SC373	AVC amplifier
Q 16	2SD146/2SC614 2SC971	DC regulator
D 1,2	1N34	Overload protector
D 3	1N73	IF noise limitor
D 4	1N34	AF detector
D 5	1N34	AF noise limitor
D 6,7	1N34	AVC detector
D 8	SZ-7	7V voltage regulator
D 9-12	1N34	Product detector
D 13,14	FR-1P	Rectifier
Th 1,2	D-1E	Temperature compensator

1. SPECIFICATIONS

1.1 Circuit .....16 transistors, 14 diodes and 4 thermistors super-heterodyne system.
Show Table 1 and Fig. 1 Schematic diagram.

1.2 Frequency .....The RF tuning system covers the following four bands:

-1 Band A 0.535 - 1.6 MHz

-2 Band B 1.55 - 4.5 MHz

-3 Band C 4.5 - 13 MHz

-4 Band D 13 - 30 MHz

1.3 Band spread.....The band spread system covers the following frequencies:

-1 80 Meter Band 3.5 - 4 MHz

-2 40 Meter Band 7 - 7.3 MHz

-3 20 Meter Band 14 - 14.35 MHz

-4 15 Meter Band 21 - 21.45 MHz

-5 10 Meter Band 28 - 29.7 MHz

1.4 Intermediate frequency .....455 KHz

1.5 Receiving sensitivity, signal to noise ratio and image ratio

Frequency	Sensitivity	S/N	Image
1400 KHz	Less than 50 μV	More than 10 dB	More than 40 dB
4 KHz	10	10	30
12 KHz	10	10	16
28 M	10	10	4

2. GENERAL ALIGNMENT INSTRUCTIONS

2.1 Test equipments

-1 Standard signal generator or test oscillator

-2 Vacuum tube voltmeter (P type)

-3 Dummy load 8 ohms

2.2 General alignment conditions

-1 Before servicing this receiver, disconnect from the power source and remove all lead wires attached to terminal connections. Remove the six screws which fasten the chassis to the bonnet, speaker leads and remove the six screws which fasten the chassis to the bottom plate. Show Item 3.1 Chassis disassembly, Fig. 2-1 attached.

-2 Knob function and it nominal position

Tuning Dia. ..... 0, on Logical Scale

Spread Dial ..... V.C. Minimum

ANL Switch ..... OFF

Mode Switch..... AM

AVC Switch ..... FAST

OPR Switch ..... REC.

BFO PITCH ..... -

AF GAIN..... Adjust to Test Requirements

Band Selector ..... Adjust to Test Requirements

Antenna trimmer ..... Center

RF Gain ..... Maximum

-3 IF AMPLIFIER ALIGNMENT

Note: The non-metallic alignment tool are required for complete alignment. Unless otherwise specified, all front panel controls shall be positioned as Item 2.2-2 knob function & nominal position for complete alignment of the receiver.

1.6 Loud speaker.....3" x 5" P.M. type

1.7 Power input & power comsumption

-1 AC117V, 50/60 cps, 6VA

-2 DC12V, 5VA, Negative ground only

1.8 Controls on the feature

-1 Tuning dial

-2 Spread dial

-3 "S" meter

-4 ANL switch (on/off)

-5 Mode switch (AM/SSB, CW)

-6 AVC switch (fast/slow)

-7 Operation switch (rec./std. by)

-8 Phones jack

-9 Band spread control

-10 BFO pitch

-11 Power on/off & AF gain control

-12 Band selector

-13 Antenna trimmer

-14 RF gain control

-15 Main tuning control

1.9 Controls on the back

-1 Antenna terminal

-2 Fuse holder & fuse

-3 DC/AC change switch

-4 DC 12V power jack

-5 STD by jack

STAGE / ADJ.	ANT. STAGE		RF. STAGE		OSC. STAGE	
	CORE	TRIM	CORE	TRIM	CORE	TRIM
BAND A	L1	VC1	L5	TC1	L9	TC5
BAND B	L2	VC1	L6	TC2	L10	TC6
BAND C	L3	VC1	L7	TC3	L11	TC7
BAND D	L4	VC1	L8	TC4	L12	TC8

Note: The oscillator adjustment are performed first.
The RF is adjusted next to obtain maximum amplitude.
The antenna cores adjusted last.

-5 B.F.O. ALIGNMENT

Note: The non-metallic alignment tool are required for complete alignment. The mode switch on the front panel should be positioned SSB/CW. A knob of the B.F.O. pitch on the front panel should be positioned one o'clock.

A. Signal coupling .....
Receive one of a broad cast frequency with exactitude by an antenna through the antenna terminal.

B. Connect V.T.V.M. .....
Connect a P type vacuum tube voltmeter probe between a side of T4 secondary coil and chassis earth.
Set the vacuum tube voltmeter range on 1.5 volt.

C. Adjust .....
Adjust the core of the B.F.O. coil T3 for a zero beat note by loud speaker.
Adjust the core of the B.F.O. coil T4 for a maximum deflection on vacuum tube voltmeter.

The receiver should be warmed up for a period of at least 1/2 hour before proceeding with the complete alignment.

A. S.G. Coupling .....
Connect the S.G. output through a capacitor (50 pF) between VC 4 and chassis earth.

B. S.G. Frequency ..... 455 KHz

C. Adjust .....
Adjust the cores of IF transformer MF, T1 and T2 for a maximum deflection on the "S" meter in a front dial.

-4 RF AMPLIFIER ALIGNMENT

Note: Alignment tool, nominal position of knobs and receiver condition should be required as Item 2.2-2 and 2.2-3.

A. S.G. Coupling .....
Connect the cable of S.G. output through a dummy antenna between A1 and GND on the antenna terminal.

B. S.G. Frequency .....
Three points characteristic alignment should be required on each A to D pass band. The plot frequency and moduration shall be positioned as follow:

BAND A ..... 600KHz, 1000KHz & 1400KHz

BAND B ..... 1.7MHz, 3MHz & 4MHz

BAND C ..... 5MHz, 8MHz & 12MHz

BAND D ..... 14MHz, 21MHz & 28MHz

MODULATION 1KHz, 30%

C. Connect V.T.V.M. .....
Connect a a-c vacuum tube voltmeter to a phones jack with 8 ohms dummy load. Keep clear of low impedance speaker voice coil.

D. Adjust .....
Adjust the cores and trimmers of antenna, RF and oscillator coils for maximum deflection. Part number of the core and trimmer is as following table;

4. PARTS LIST AND DESCRIPTION

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
Q1.3.4.7	Transistor	2SK19	
Q5.6.8.9	"	2SC372	
Q2.10.11.12.15	"	2SC373	
Q13.14	"	2SD72	
Q16	"	2SD146 or equivalent	
Th1.2	Thermistor	M-10K	
Th3.4	"	D-1E	
D1.2.4.5.6.7. 9.10.11.12	Diode	1N34A	
D3	"	1S73	
D13.14	"	FR1P	
D8	"	SZ-7	
D15	"	SZ-9	
T5	Power transformer	R6213	
T6	Input transformer	S9563C	
MF1	Mechanical filtor	MFH-40K	
T1	IFT-1	YMC-15001A	
T2.4	IFT-2 & BFO buffer coil	YMC-15002A	
T3	BFO coil	HY-0112C	
L1	A band ANT. coil	12BNA-001	
L5	A band RF coil	7TNR-014	
L9	A band OSC coil	7TNO-015	
L2	B band ANT coil	7TNA-016	

3. INSTRUCTION FOR REPLACEMENT OF CHASSIS AND DIAL CORD ASSEMBLY

3.1 CHASSIS DIS-ASSEMBLY

Show Fig. 5 attached and Item 2.2-1

Note: Before the cabinet dis-assembly, pull out two of tips with speaker lead from loud speaker.

3.2 DIAL CORD ASSEMBLY

-1 Main tuning dial cord assembly show the Fig. 9 attached.

-2 Bandspread dial cord assembly show the Fig.10 attached.

3.3 KNOB SETTING POSITION FOR B.F.O. PITCH & ANTENNA TRIMMER

Set the knob slit on nine o'clock when a capacity of variable capacitor should be made maximum value.

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
R22.44.65	Resistor 1/4W	3.3K ohms	
R16.26.33.38.45	" "	4.7K ohms	
R27.53	" "	6.8K ohms	
R2.4.5.13.23.25.52	" "	10K ohms	
R34.39	" "	15K ohms	
R17	" "	27K ohms	
R54	" "	39K ohms	
R32	" "	47K ohms	
R1	" "	100K ohms	
R24.40.41.42.43.48.49	" "	470K ohms	
R8	" "	1M ohms	
R20.46.50	" "	2.2M ohms	
R62.63	" 1/2W	4.7 ohms	
C7	Ceramic capacitor	5 pF 50WV	
C33	"	20 pF 50WV	
C53.57	"	50 pF 50WV	
C32	"	100 pF 50WV	
C1	"	150 pF 50WV	
C4.6.14	"	0.01 MF 50WV	
C22.23	"	0.02 MF 50WV	
C5.8.15.16.17.18.19.21.36.48.49.50.13	"	0.04 MF 50WV	

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
L6	B band RF coil	7TNR-017	
L10	B band OSC coil	7TNO-018	
L3	C band ANT coil	7TNA-019	
L7	C band RF coil	7TNR-020	
L11	C band OSC coil	7TNO-021	
L4	D band ANT coil	7TNA-022	
L8	D band RF coil	7TNR-023	
L12	D band OSC coil	7TNO-024	
L13	250 μH peaking coil	4LNC-025	
R3.56	Resistor 1/4W	22 ohms	
R58.60.66	" "	47 ohms	
R31	" "	100 ohms	
R6.10.29	" "	120 ohms	
R51	" "	150 ohms	
R57.64	" "	220 ohms	
R30	" "	270 ohms	
R7.65	" "	330 ohms	
R11.18.21.28.35.55	" "	470 ohms	
R64	" "	910 ohms	
R12.14.15.19.36.37.47	" "	1K ohms	
R9	" "	1.5K ohms	
R59.61	" "	1.8K ohms	

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
	Printed circuit board	GE-13B-1009	
	"	GE-13D-1010	
	Chassis	GE-11B-521A	
	Bottom plate	GE-11C-535A	
	Side angle-1	GE-11D-533-1A	
	" -2	GE-11D-533-2A	
	Sub panel	GE-11D-534	
	VC mounting bracket	GE-11D-538A	
	Sub PC mounting bracket	GE-11D-593	
	Coil mounting chassis	GE-11D-577-A	
	Back panel	GE-11C-522A	
	Dial plate mounting bracket	GE-11C-537A	
	Cabinet	GE-11B-552	
	Dial pointer		
	Spread pointer		
	Variable capacitor	ECV-3HA43A21	
	"	2JJ02A18	
	"	S-30-60 pF	
	Pulley	90ø	
	"	70ø	
	"	40ø	
	Trimmer	B4-IM2	
	"	AT4-51/AT4-61	

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
C61	Mylar capacitor	0.005 MF 50WV	
C51.52.54	"	0.01 MF 50WV	
C35.43	"	0.04 MF 50WV	
C25.26.28.55	"	0.1 MF 50WV	
C41	Styrol capacitor	10 pF 50WV	
C9	"	33 pF 50WV	
C2.42	"	68 pF 50WV	
C45	"	100 pF 50WV	
C37	"	150 pF 50WV	
C3	"	220 pF 50WV	
C11.38	"	470 pF 50WV	
C47	"	1000 pF 50WV	
C39	"	1500 pF 50WV	
C12.40	"	5000 pF 50WV	
C44	"	10000 pF 50WV	
C63	Oil capacitor	0.001 500WV	
C31.56.58	Chemical capacitor	1 MF 16WV	
C20	"	5MF 16WV	
C27	"	10 MF 16WV	
C24.46.59.62	"	50 MF 16WV	
C29.60	"	200 MF 16WV	
C34.65.66	"	500 MF 16WV	
C64	"	2000 MF 16WV	
C30	"	30 MF 16WV	

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
	Main dial plate		
	Front panel	GE-11B-536	
	Heat sink L type		
	Heat sink saddle		
	Knob	Large	
	"	Small	
	Back board	GE-11D-587A	
	SPK board	GE-11D-595	
	Bar Ant. holder		
	Instruction manual		

Symbol No. or Item No.	Description	Rating or Stock No.	Remarks
	Rotary switch	Y6124	
SW11	Slide switch	9L	
SW7.9.12.8	"	14L	
	Volume	5KA C24S-SA21	
	RF control	2KB	
	Fuse holder		
	Fuse	0.5A	
	DC concent	4P NO.1476	
	2-pin plug & socket	NO.3822	
	Line cord strain relief		
	Foot	No.4850 #20	
	Rubber grommet	No.4108	
	Pilot lamp	8V	
	"	Lead type	
	Pilot lamp socket		
	Ant terminal	3P	
	Phones jack		
	S meter		
	Line cord	UL Type 6 feet	
	Main dial shaft	GE-12D-726	
	Spread dial shaft	GE-12D-728	
	"	GE-12D-727	
	Spread dial plate		

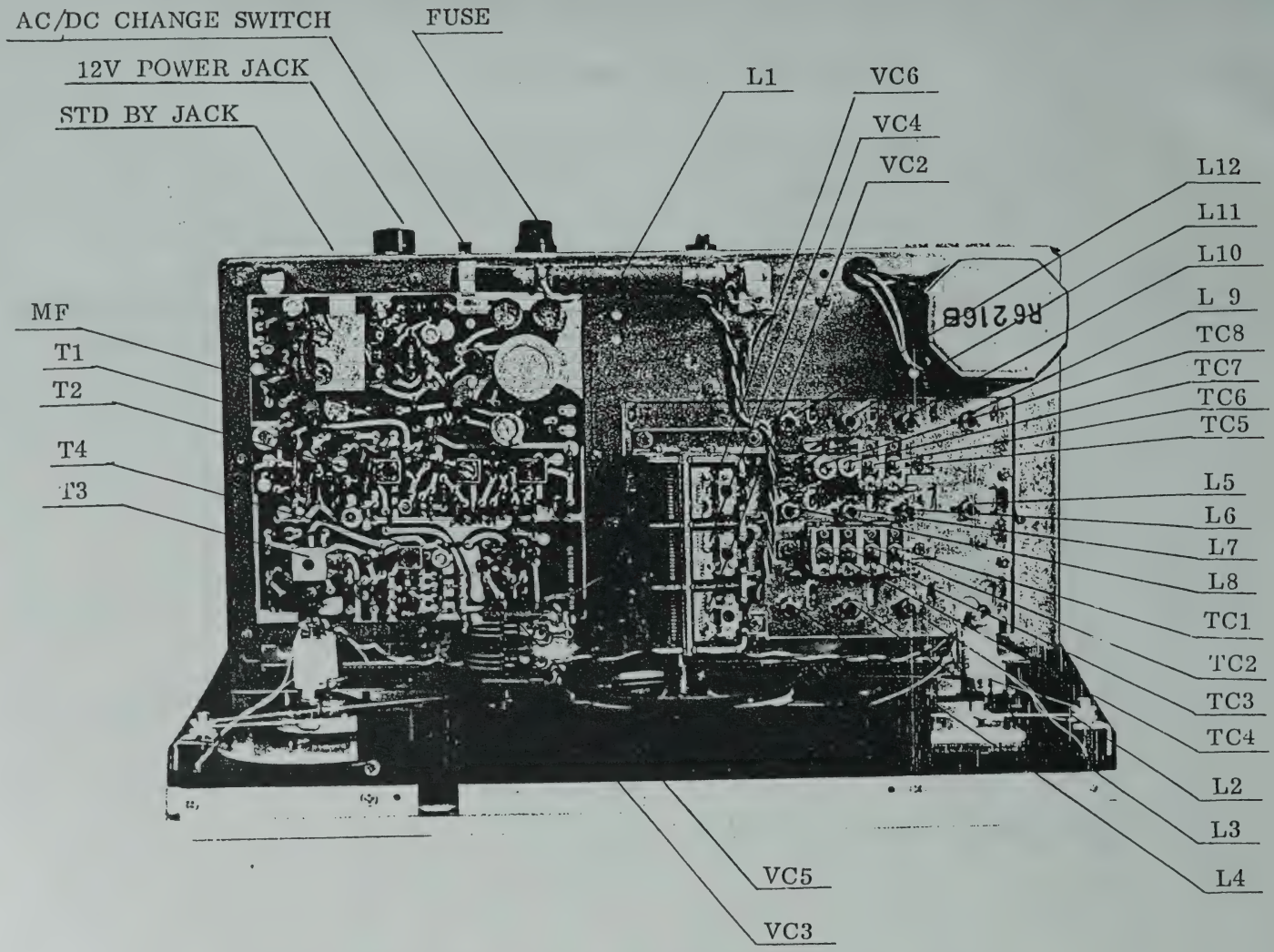


FIG. 2 TOP VIEW OF DX-150A CHASSIS PARTS LOCATION

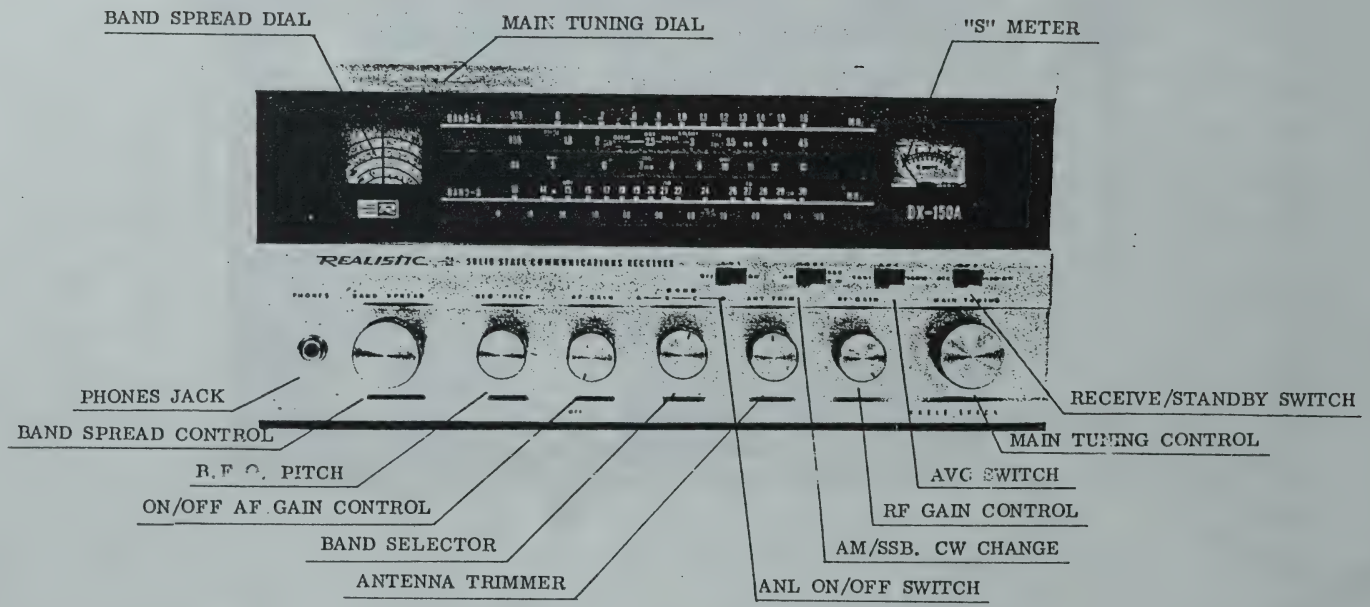
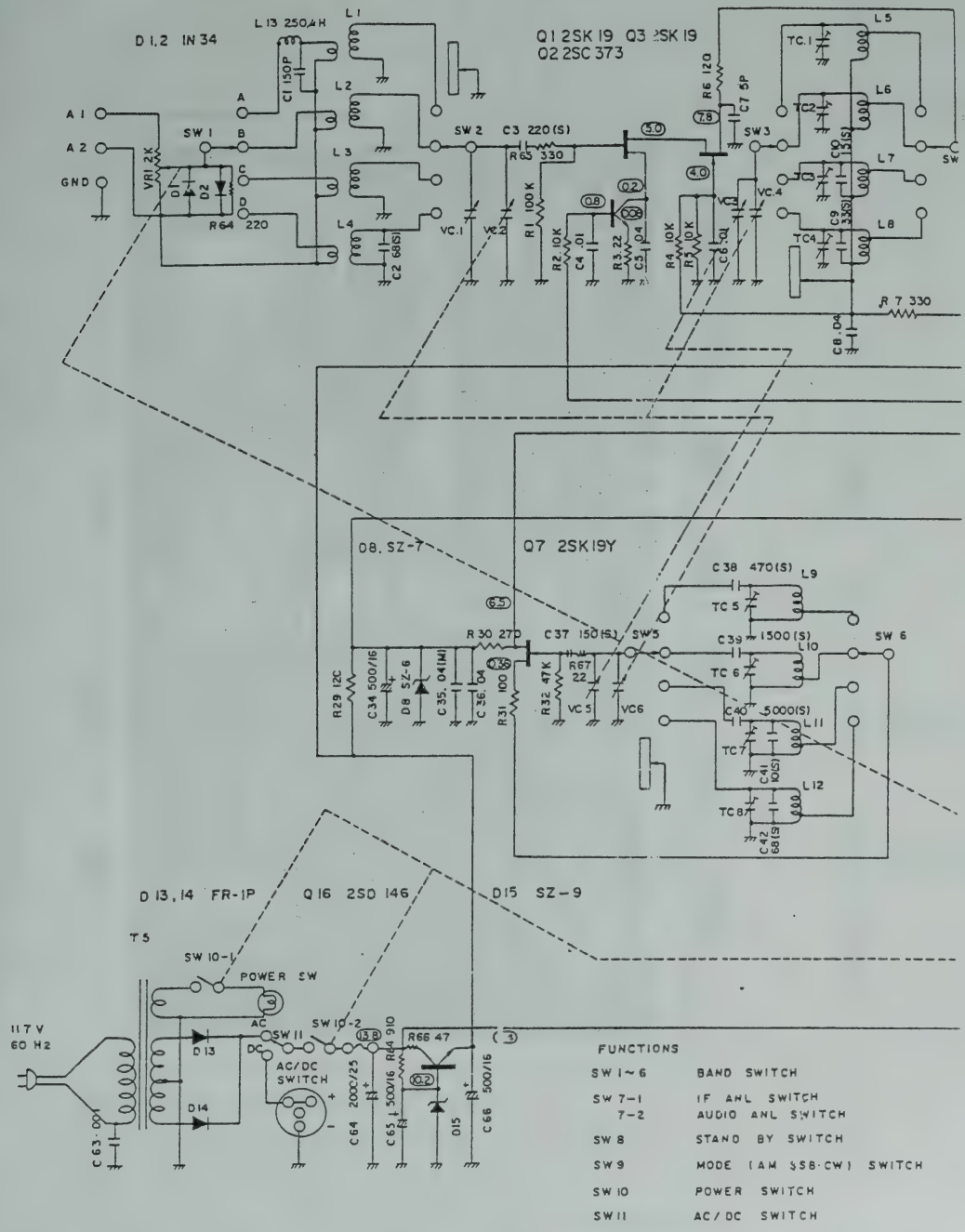


FIG 1 FRONT VIEW OF DX-150A CHASSIS


D1,2 IN34
L13 250μH
C1 150P
Q1 2SK19 Q3 2SK19
Q2 2SC373
R6 120
C7 5P
TC1
L5
TC2
L6
C9 33(S)
L7
TC3
TC4
L8
C8 .04
R7 330
SW1
SW2
SW3
C3 220(S)
R65 330
R1 100K
R2 10K
C4 .01
R3 22
C5 .04
R4 10K
R5 10K
C6 .01
VC1
VC2
VC3
VC4
A1
A2
GND
VR1 2K
D1
D2
R64 220
L1
L2
L3
L4
C2 68(S)
Q8, SZ-7
Q7 2SK19Y
C38 470(S)
L9
TC5
C39 1500(S)
L10
TC6
C40 5000(S)
L11
TC7
C41 10(S)
L12
TC8
C42 68(S)
SW6
R30 270
C37 150(S)
R67 22
R32 47K
R31 100
R29 12C
C34 500/16
D8 SZ-6
C35 .04(MI)
C36 .04
VC5
VC6
D13,14 FR-1P
Q16 2SD146
D15 SZ-9
T5
SW10-1
POWER SW
SW10-2
SW11
AC/DC SWITCH
117 V
60 Hz
C63 .01
D13
D14
R66 47
R44 910
C64 2000/25
C65 500/16
D15
C66 500/16
FUNCTIONS
SW 1~6 BAND SWITCH
SW 7-1 IF ANL SWITCH
7-2 AUDIO ANL SWITCH
SW 8 STAND BY SWITCH
SW 9 MODE (AM SSB CW) SWITCH
SW 10 POWER SWITCH
SW 11 AC/DC SWITCH

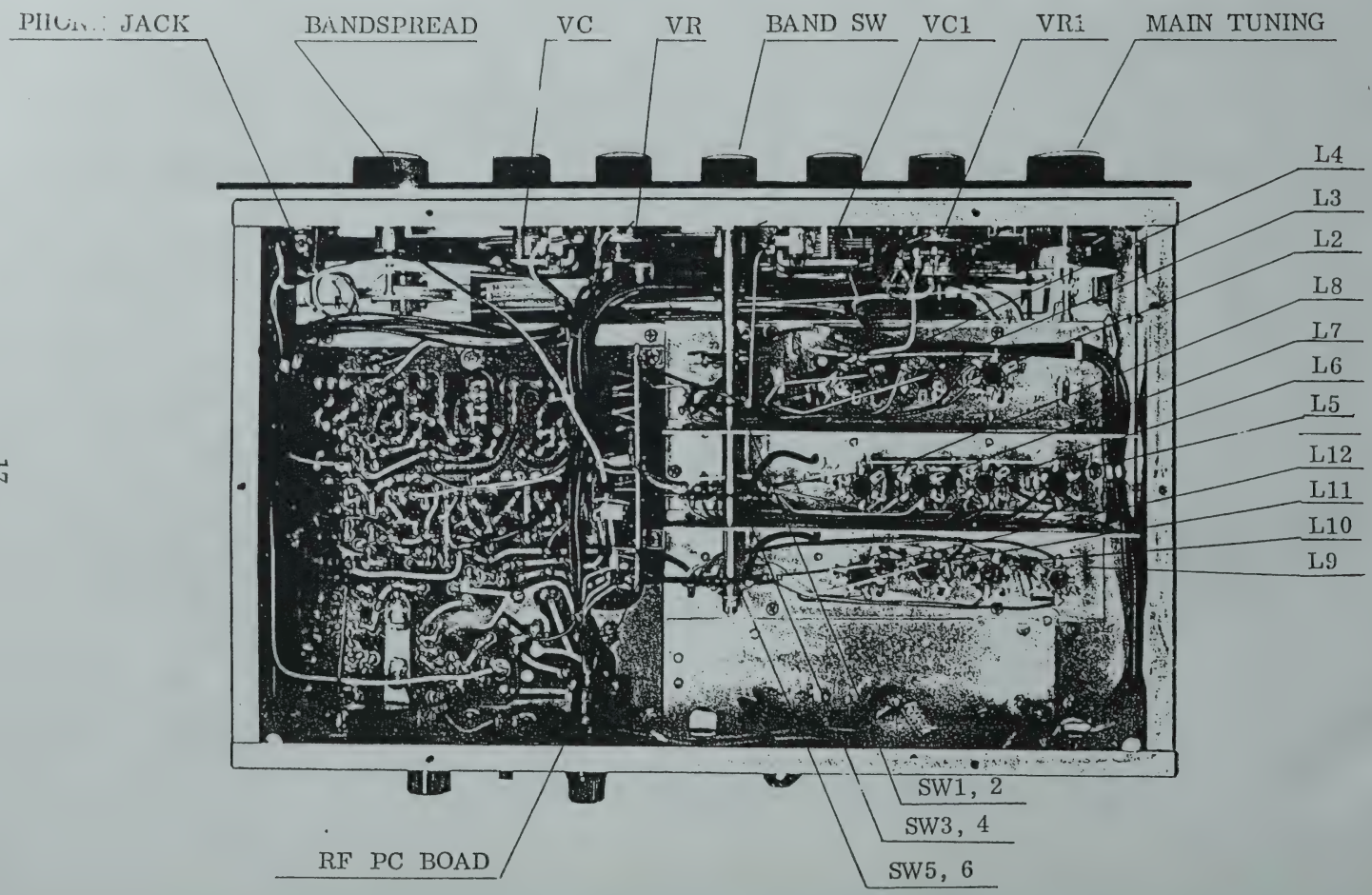
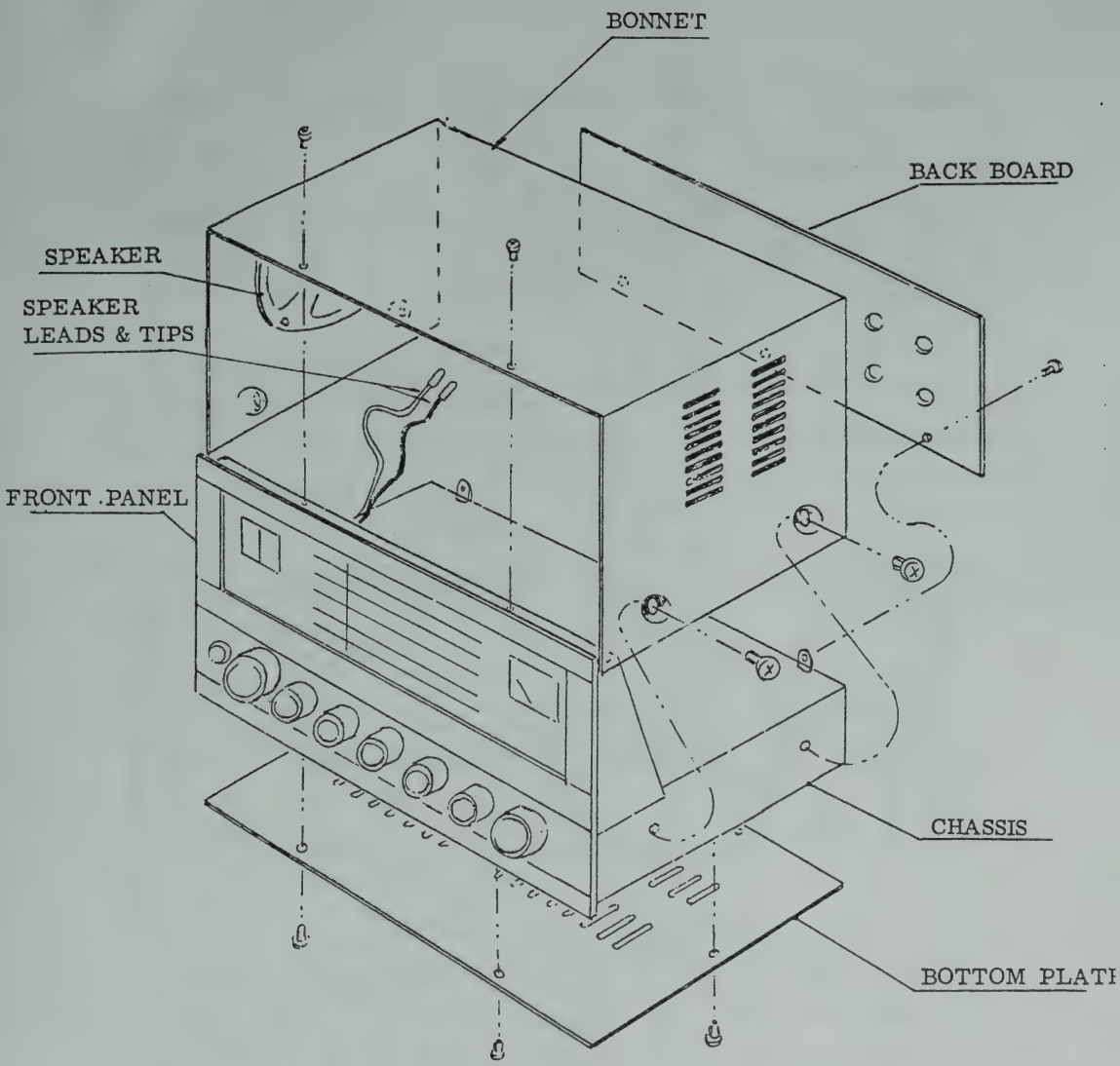


FIG. 3 REAR VIEW OF DX-150A CHASSIS PARTS LOCATION



Note: Before the chassis dis-assembly, take pull out two of TIPS with speaker lead wires.

FIG. 5 CHASSIS DIS-ASSEMBLY

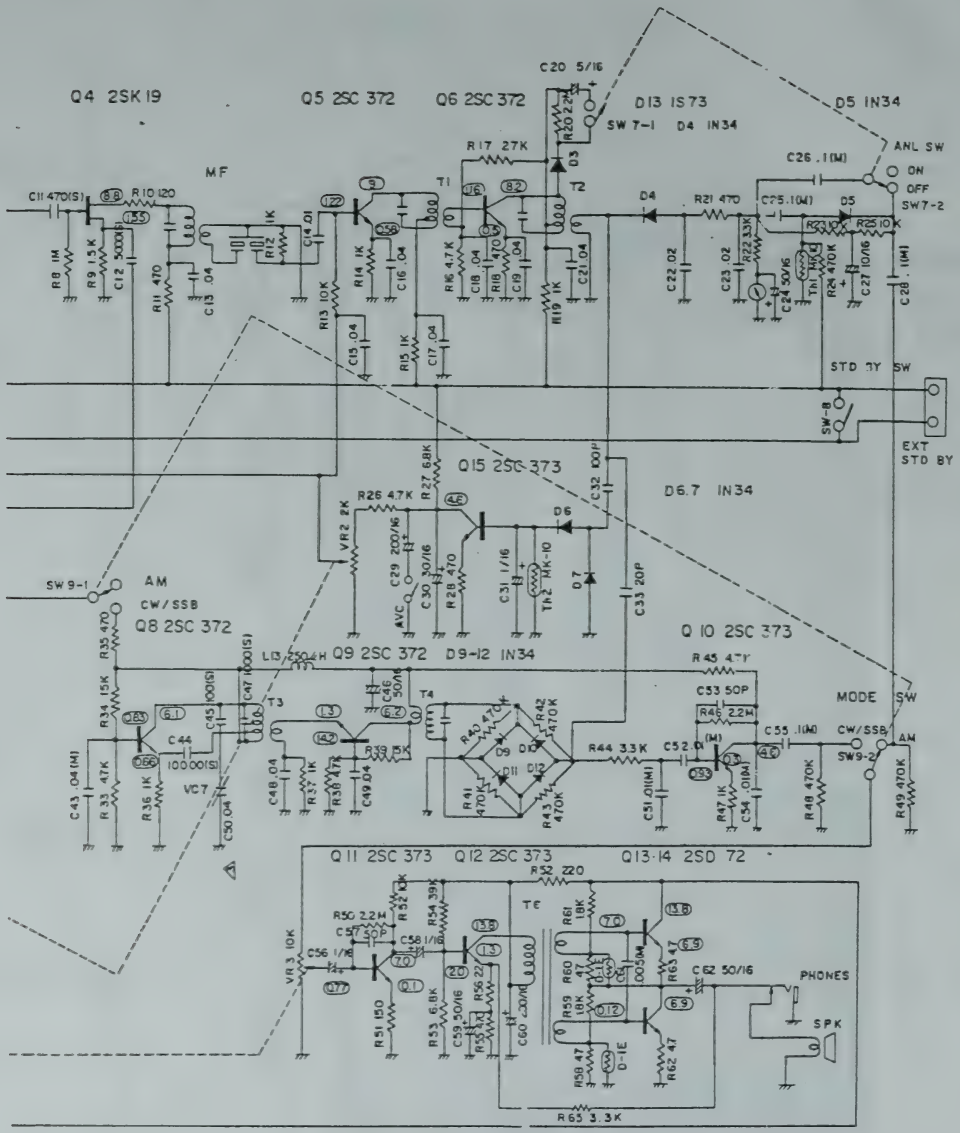


FIG. 4 SCHEMATIC DIAGRAM

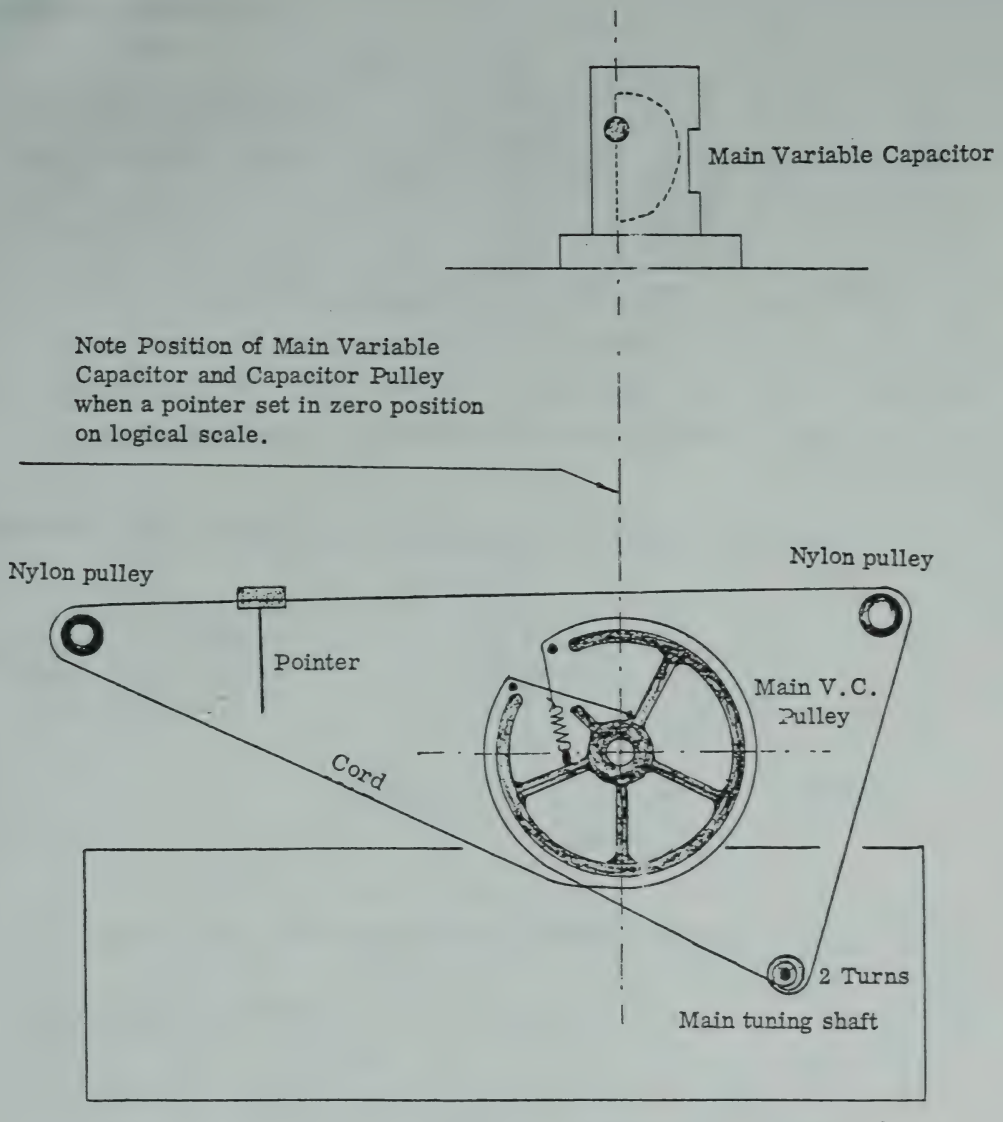
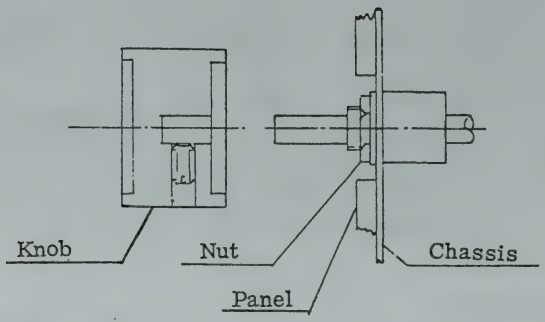

Main Variable Capacitor
Note Position of Main Variable Capacitor and Capacitor Pulley when a pointer set in zero position on logical scale.
Nylon pulley
Nylon pulley
Pointer
Main V.C. Pulley
Cord
2 Turns
Main tuning shaft

FIG. 9 MAIN TUNING DIAL CORD ASSEMBLY

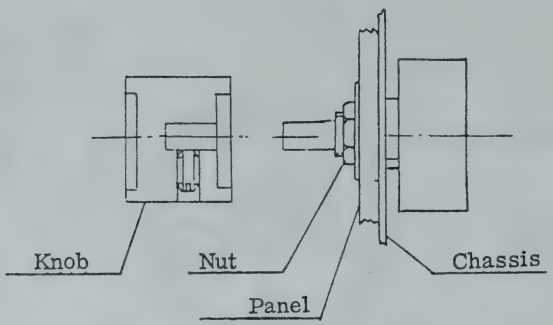


KNOB & SHAFT ASSEMBLY

for

Bandspread control shaft
Band selector shaft
main tuning control shaft

FIG. 6 KNOB & SHAFT ASSEMBLY FOR BANDSPREAD



KNOB & SHAFT ASSEMBLY

for

BFO pitch shaft
ON/OFF, AF gain control shaft
Antenna trimmer shaft
RF gain control shaft

FIG. 7 KNOB & SHAFT ASSEMBLY FOR BFO PITCH

PHONE JACK ASSEMBLY

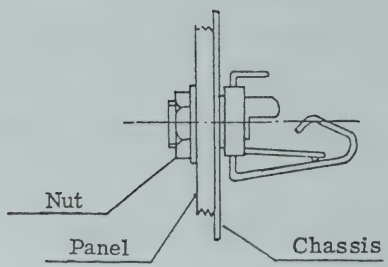


FIG. 8 PHONES JACK ASSEMBLY

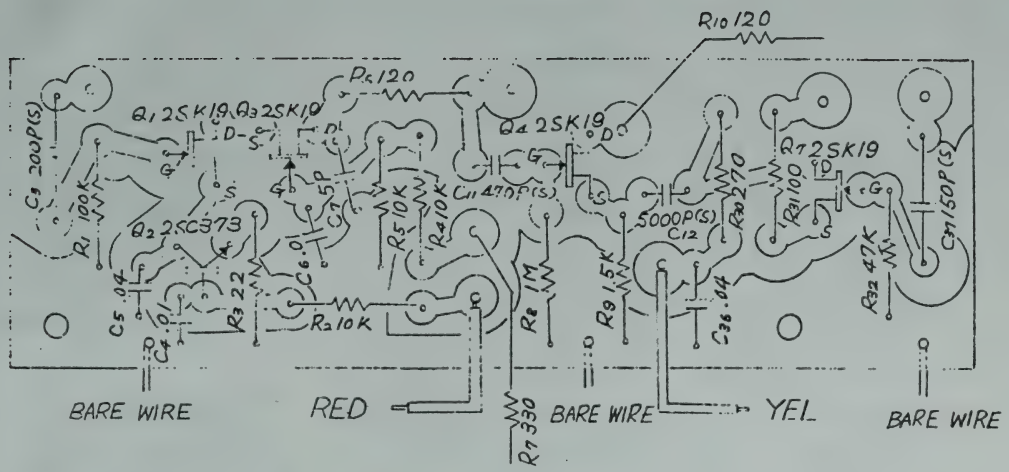


FIG.11 SUB PRINTED CIRCUIT BOARD TOP VIEW

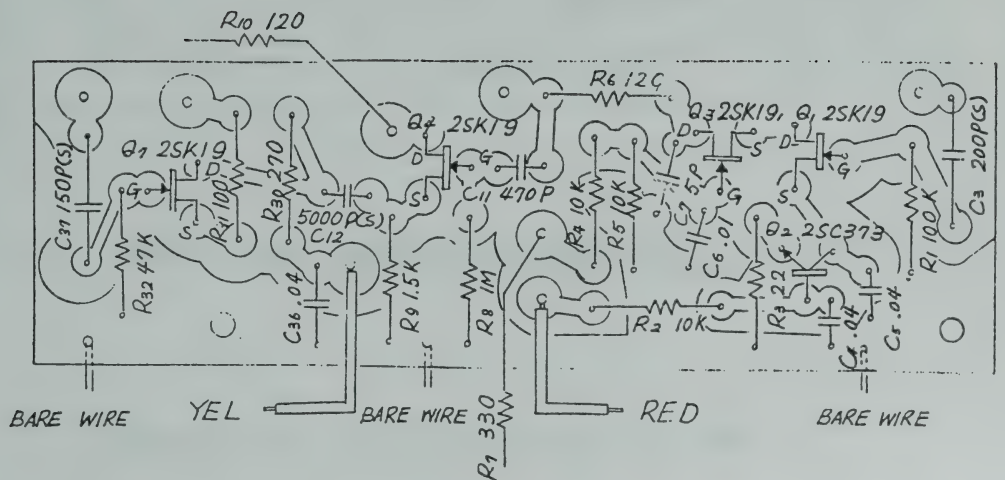
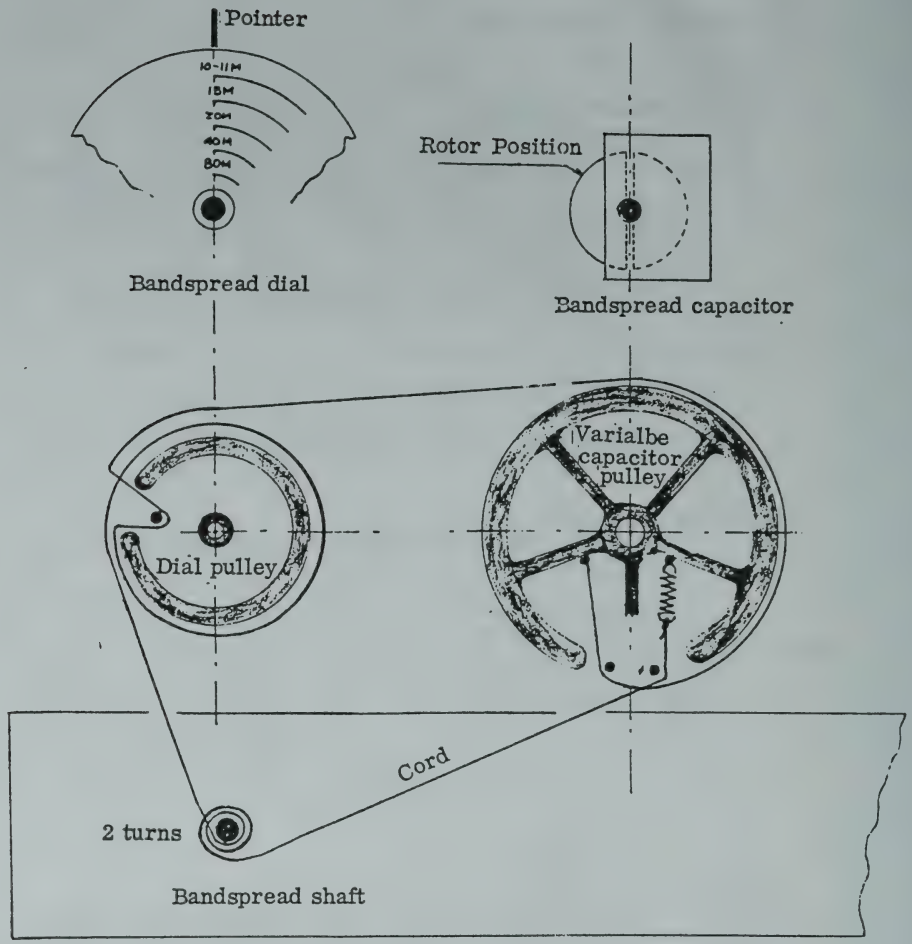


FIG.12 SUB PRINTED CIRCUIT BOARD REAR VIEW



Four of Note position for Bandspread Dial, Dial pulley, Variable capacitor and Capacitor pulley.

FIG.10 BANDSPREAD DIAL CORD ASSEMBLY

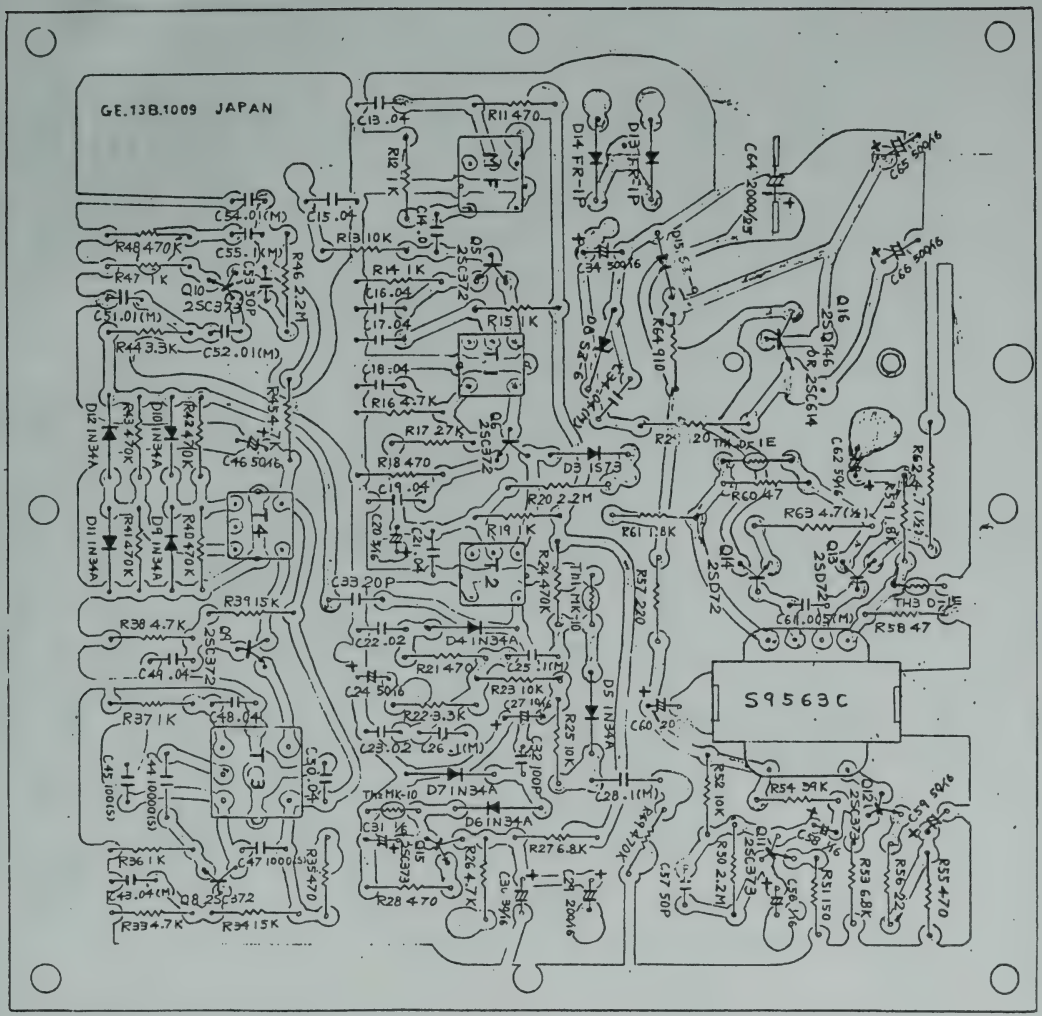


FIG.14 MAIN PRINTED CIRCUIT BOARD REAR VIEW

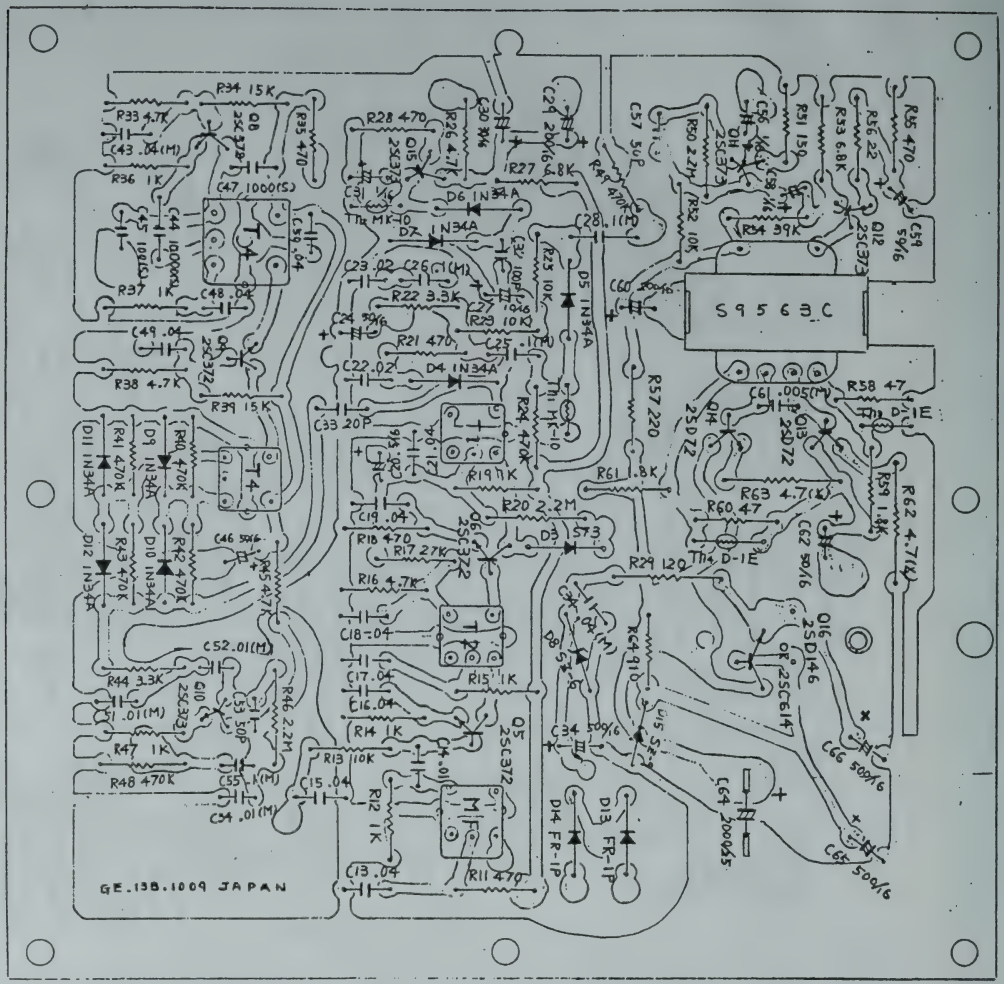


FIG.13 MAIN PRINTED CIRCUIT BOARD TOP VIEW

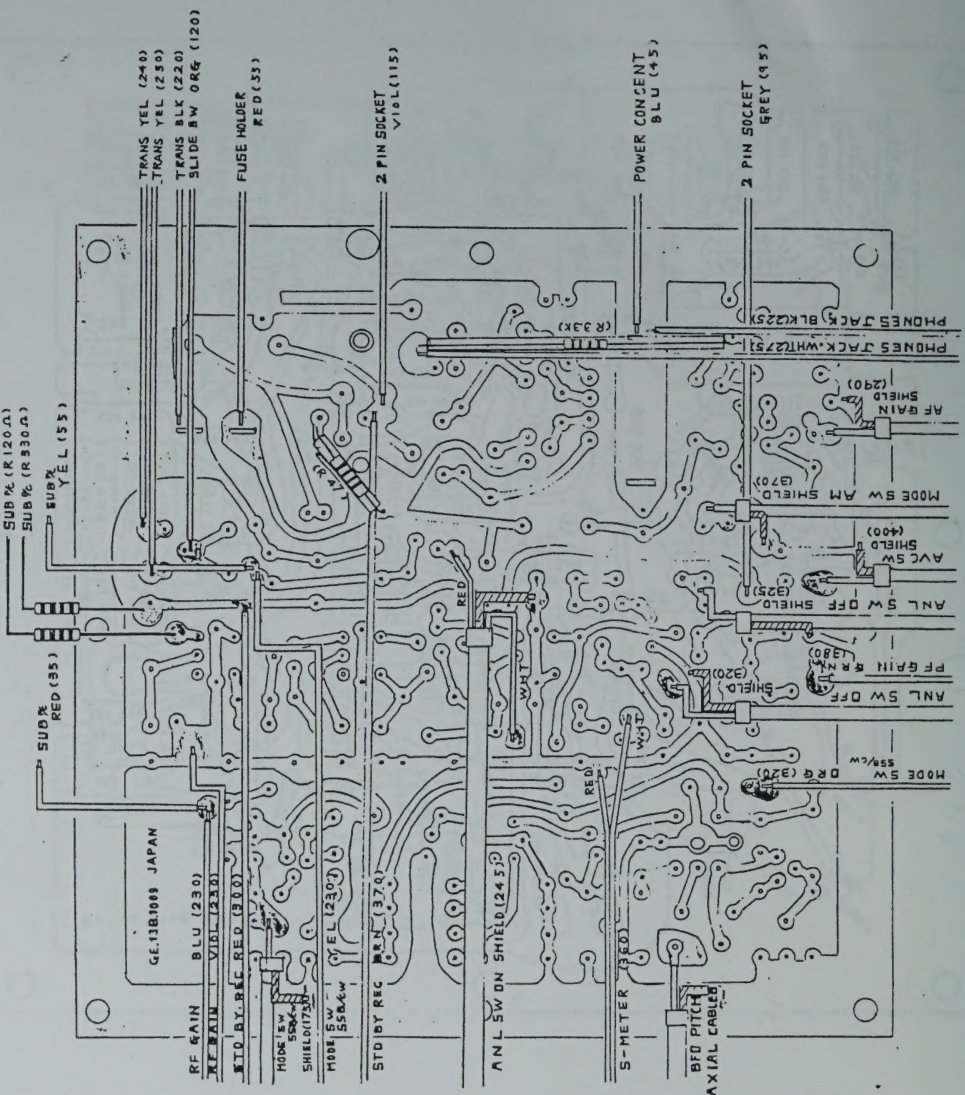


FIG.15 MAIN PRINTED WIRING DIAGRAM

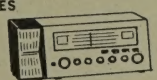
No, we're not lazy! It's just that "Popular Electronics" (Dec. 1967) tells the DX-150 story so well.

Reprinted Without Editing

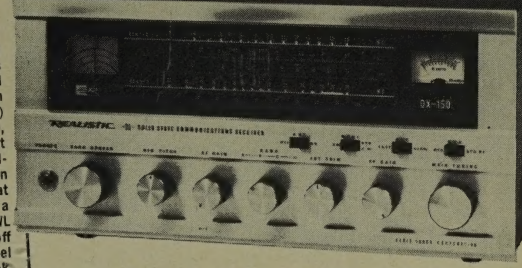
"What may be the first really noteworthy advancement in communications receivers is wrapped up in the new Radio Shack imported DX-150. Featuring continuous coverage from the top of the AM broadcast band (535 kHz) to the bottom of the 10-meter band (30 MHz), the DX-150 is a single-conversion superhet with a tuned r.f. stage, two i.f. stages, full-wave product detector for SSB/CW reception — and it's 100% solid state. Selling at $119.95, the DX-150 has the flexibility of a communications receiver that a ham or SWL is used to buying for $175-plus. To rattle off a few more "features": there is a front panel antenna trimmer, fast or slow a.v.c. attack, a cleverly concealed built-in monitor speaker, plenty of calibrated bandspread, and noise limiting in both the i.f. and audio stages. Because of the solid state circuitry, the usual warm-up drift expected with a tube-type receiver is virtually absent here. And, although the DX-150 is primarily a base station receiver with a 117-volt a.c. power connection, it can be operated from an outboard d.c. power supply consisting of only 8 D-cells. Radio Shack claims that the receiver will operate for 100 hours — continuously — using only the d.c. supply. Ideal for Field Day and emergency work! The proof of the pudding so far as any communications receiver is concerned is how well it works "on the air". At POPULAR ELECTRONICS, the DX-150 was hooked up to a 125-foot long-wire antenna and tuned across the AM broadcast band. Needless to say, the S-meter was pinned on just about every single channel, and the audio quality with Radio Shack's voice-selective speaker (extra, $7.95) was crystal-clear. Tuning the band between 1.55 and 4.5 MHz, your reviewer got a chance to appreciate the comfortable handling on SSB reception. Going a little higher (4.5-13.0 MHz), the 25- and 31-meter bands were "alive" and signals appeared to leap out of the air — possibly due to the very quiet background of the DX-150. While quietness is usually regarded as a lack of sensitivity, that wasn't the case with the DX-150. On the top band (13-30 MHz), the sensitivity still seemed high; and on the CB frequencies, the DX-150 could hold its own against a dual-conversion receiver built just for CB work. **Summary:** Radio Shack has the Model DX-150 in most of its 160 retail outlets. Take a look at it, and get the "feel" of this unusual receiver."

CUSTOM ACCESSORIES

12 VDC Power Set



Matching Speaker



And only Radio Shack has this 119.95 receiver!

Thousands of hams and swl's have discovered that Radio Shack's Realistic DX-150 is truly the "breakthrough" full coverage receiver of 1968. It's the 100% solid state receiver that *banishes forever* tube failure, tube heat, tube drift, and — thanks to its built-in 117V/12V supply — your dependence upon AC current when power fails or on field day. The brilliant DX-150 is NOW IN STOCK in every one of Radio Shack's over 200 stores.

CAVEAT EMPTOR

Since DX-150 is certain to be the world's most imitated communications product, we advise our readers that "solid state" on a receiver is not necessarily indicative of selectivity, sensitivity and "feel." The DX-150 is built to $200-$300 performance specifications; its modest $119.95 price tag simply designates the extent to which we have sacrificed traditional markup to establish REALISTIC as a quality line! P.S. — DX-150 is a hefty 14 lbs., with a 12¼" dial, extruded 11-control front panel, and 14¼x8¼x6½" in size. It's just the picture that's little! Our no money down policy makes the pain little, too!

FILL IN AND MAIL ORDER TODAY!

RADIO SHACK { **EAST:** 730 Commonwealth Ave., Boston, Mass. 02215 **WEST:** 2615 West 7th St., Fort Worth, Texas 76107

Please rush me the item I've checked below. Dept. 73m-34
I enclose $_____, plus 50¢ for postage and handling:

- ☐ FREE 1968 Catalog
- ☐ Matching Speaker, 20-1500, $7.95
- ☐ Receiver, 20-150, $119.95
- ☐ 12 VDC Power Set, 20-1501, $7.95

Name (print) _____

Street _____

City _____ State _____ Zip _____

secondary (or even more remote copies) versions.

The NBS primary standards agree with the definitions adopted by the International Committee on Weights and Measures. These definitions establish the "ampere" as an electric current which would produce between two conductors of infinite length and negligible cross-section separated by one meter distance in a vacuum, a force of 0.0000002 newton per meter. The "volt" is then defined as the potential which causes a dissipation of one watt when a current of one ampere flows, and the "ohm" as the resistance which permits one ampere to flow when one volt potential appears across it. The coulomb (unit of electrical charge) is similarly defined as the amount of charge transported in one second by a current of one ampere, while the farad and the henry are also defined in terms of coulombs, volts, and amperes.

These "standard" definitions may sound as if they go in a circle—to measure any one of them you must already know all the others. In practice, that's just about the case.

It *is* possible to measure the forces involved in the definition of an ampere and so determine a standard ampere directly—but since the ampere exists only while current is flowing, the standard ampere cannot be preserved to use as a comparison standard!

The procedure actually followed to establish a primary standard, as a result, is to build coils in such a manner that their inductance can be calculated very accurately and then to use these coils together with a standard one-ampere current to measure out standard resistances. The resistance standard, together with the current-measuring devices, permits establishment of a voltage standard.

The primary standard which result provide permanent references for measurement of both voltage and resistance; the current standard—which is the only one which can be established directly in the first place—is then derived from the voltage and resistance standards whenever it is needed.

If you want some exact figures for standards, the coulomb (which is the unit of electrical charge) is supposed to be the charge of 6,280,000,000,000,000,000 electrons, give or take a few million billion. The ampere is derived from this as the number of coulombs which pass a given point in one second. The ohm is defined by some as the resistance of a column of mercury at 0° C, having a length of 106.300 cm, a mass of 14.4521 grams, and constant cross-sectional area; the volt is then defined as the potential which permits one ampere to pass through one ohm.

For everyday purposes these official standards don't give us much help. Simply determining the basic standards accurately enough for any use is a most delicate and costly operation. Fortunately, there are many "standards" readily available which are accurate enough for almost all our uses.

For instance, you can buy resistors which are guaranteed to be 1% accurate for less than a dollar. If you need accuracy of 0.01% you can get this too, but it will cost a little more. For most ham applications, since our meters themselves are only 2% accurate at best, the 1% standards are plenty good.

A mercury cell is a pretty good voltage standard, since it produces 1.34 volts for essentially its entire life. In a pinch you can even get by with a *fresh* size D flashlight cell, which should produce 1.561 volts, but the voltage of these carbon-zinc dry cells varies with age and so they are not so trustworthy.

A zener diode offers another standard-voltage reference. While most such diodes are rated to only 5% accuracy, any one diode will have a constant voltage drop throughout its life if it is not abused, and so it can be used as a secondary standard once you have calibrated it against some more accurate primary standard.

The best frequency standard is a quartz-crystal oscillator which has been calibrated against the transmissions of WWV. However, commercial AM broadcast stations are required by law to remain within a 20 Hz of their assigned frequency, and you can use a VFO which has been zero-beat against a broadcast station to provide a reasonably accurate standard in an emergency.

The one item you should *not* use as a standard is a meter, no matter how costly or how accurate its rating. Meters are sufficiently delicate that any small shock can throw them off; their accuracy should never be trusted except immediately after they have been compared to some known standard. This process is called "calibration" and should be carried out at regular intervals for all meters, although almost none of us do so.

Next month. As our series draws toward its close, we'll move closer to the state of today's art and take a look at semiconductors. ■